4.3

Random Variable

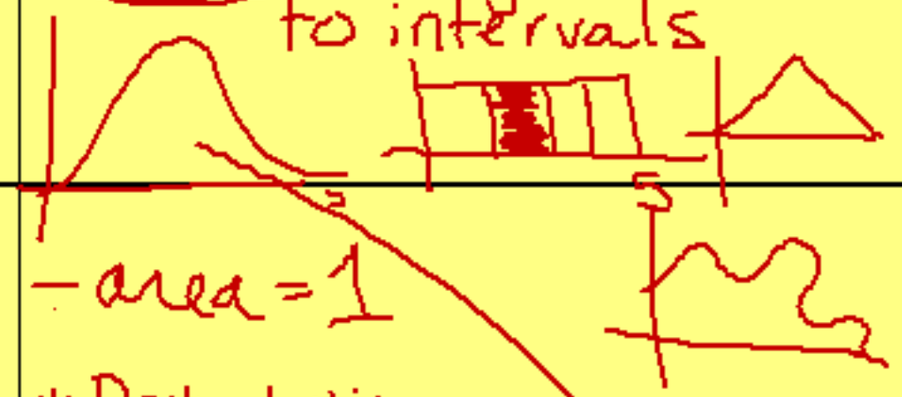
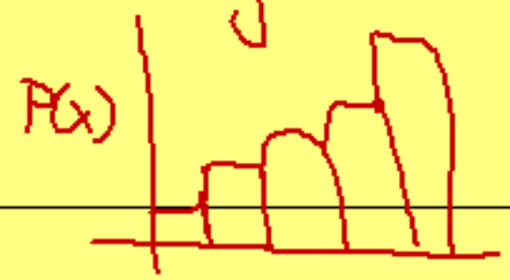
Expts:
flip a coin: H, T non-numerical
dice: 1-6 numerical

- function
- associate #'s with every outcome of an expt.
- with multiple trials, assign #s to outcomes

Ex: coinflip ×10
R.V. = # of heads
= 0, 1, 2, 3, ..., 9, 10
↑ Certain values

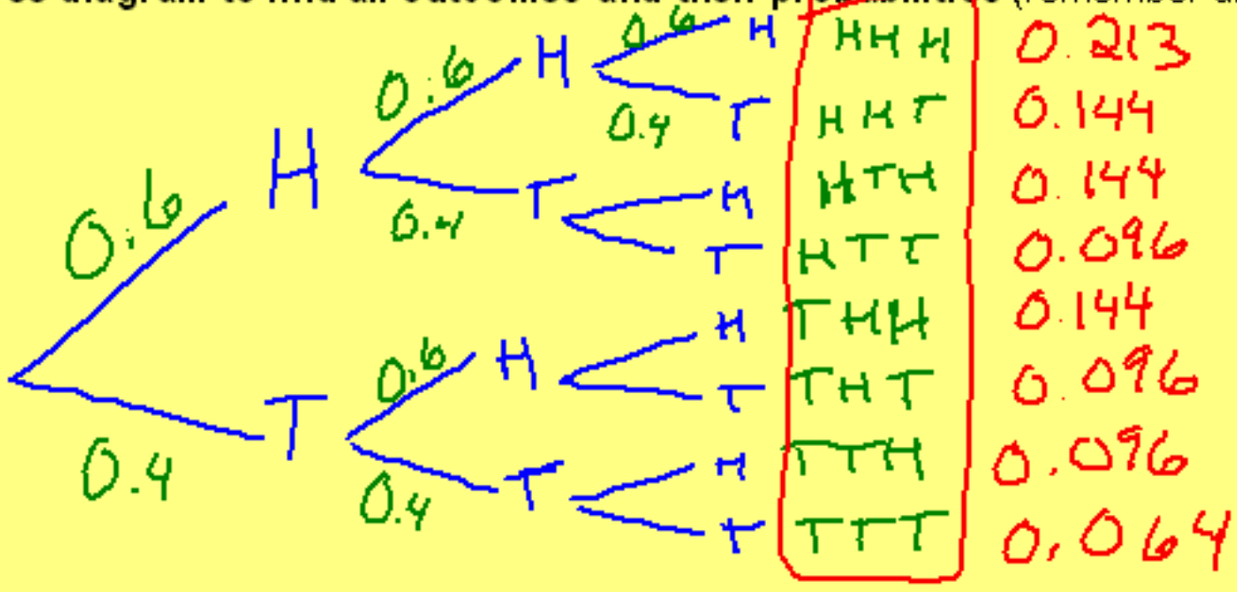
Ex: light bulbs
RV = # hrs burned
= 0 — ∞
↑ any value

Random Variable : 2 TYPES

	DISCRETE Random Variables	CONTINUOUS Random Variables
What is it?	Ex: coin flip - only takes certain distinct values - finite # Ex: 0.5, 1, 1.5, 2, 2.5, ...	Ex: light bulb 0 - 2,000 - takes any values in an interval — infinite #
Examples:	# kids in a family # defective comp. chip in a box	- height - weight - time to run a mile
Distribution/ Function - picture - prob.	Prob. Distrib. X | x1 | x2 | x3 ..... x_n P(x) | P(x1) | P(x2) | $P(x_n)$	CH. 1 - assign probabilities to intervals 
Properties of Distribution	Picture: histogram  P(x) x P(x=4) P(2≤x≤8)	- area = 1 * Probability Density Fctn P(2≤x≤8) P(x=4)=0 normalcdf(lo, up, μ, σ)

Example: Unfair Coin P(H) = 0.6, P(T) = 0.4 Toss 3 times, X = # of Heads

Create a tree diagram to find all outcomes and their probabilities (remember all trials are independent):



Using the outcomes and their probabilities, create a probability distribution below:

* ← # heads

X	0	1	2	3
P(X)	TTT	HTT THT TTH	HHT HTH THH	HHH
	0.064	0.096 x 3 = 0.288	0.144 x 3 = 0.432	0.213

How can we find the probabilities without the tree diagram?

Formula: $P(X=k) = \binom{n}{k} p^k (1-p)^{n-k}$

k: # of successes; $\binom{n}{k}$: nCk; p: prob of success; n: total # of trials

Coin Example:

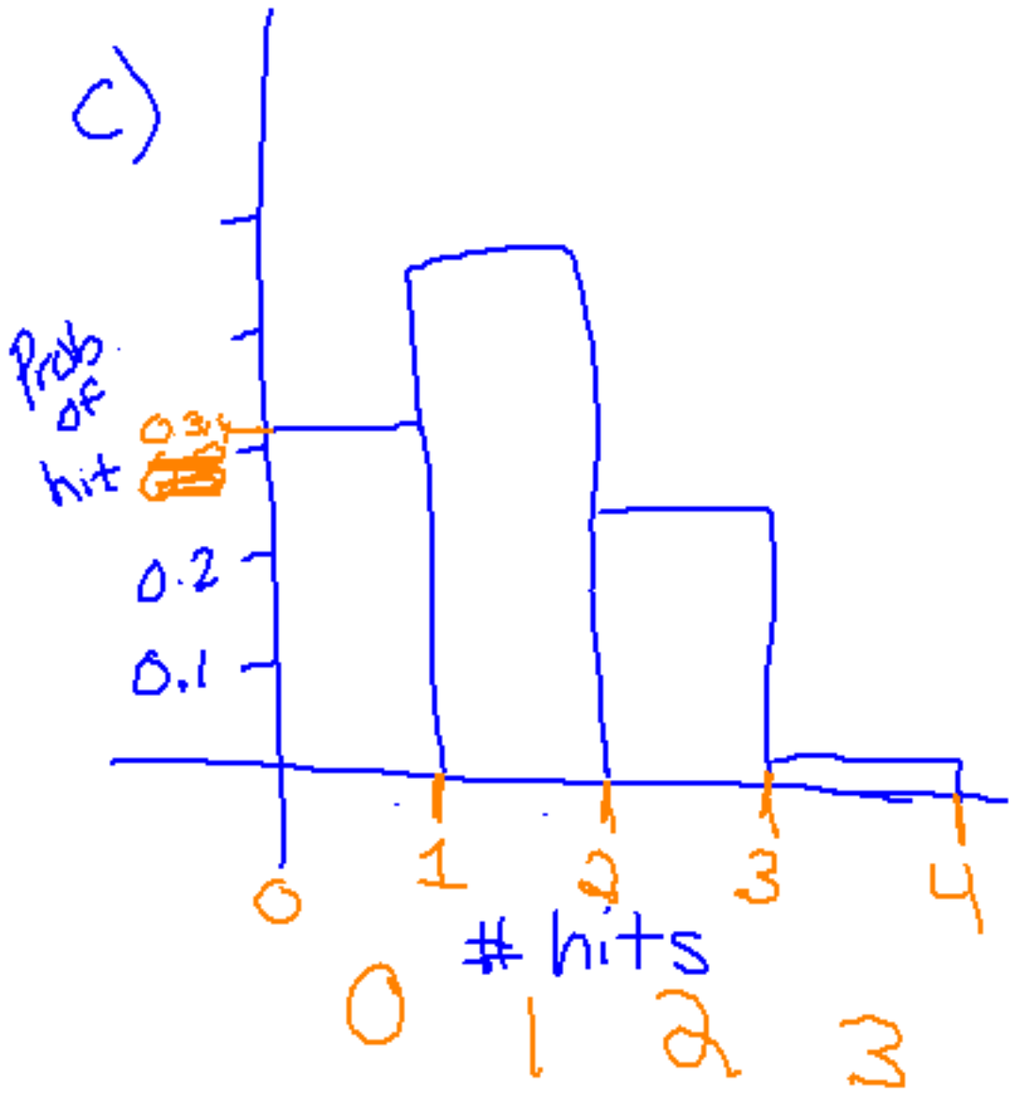
x	P(X)
0	$(3nCr0)(0.6^0)(0.4^3) =$
1	$(3nCr1)(0.6^1)(0.4^2) =$
2	$(3nCr2)(0.6^2)(0.4^1) =$
3	$(3nCr3)(0.6^3)(0.4^0) =$
4	=
5	=
6	=

a) HHH
HHO
HOH
OHH
OOH
OHO
HOO
OOO

b)

x	P(x)
0	$(3nCr0)(0.32^0)(0.68^3) = 0.314432$
1	$(3nCr1)(0.32^1)(0.68^2) = 0.443904$
2	0.208896
3	0.032768

c)



d)

$P(X=3) = 0.0327768$

$P(X=1 \text{ or } X=2) = 0.6528$

$P(X<1) = P(X=0) = 0.314432$

$P(X>1) = P(X \geq 2) = 0.241664$

$P(X=2) = 0.208896$